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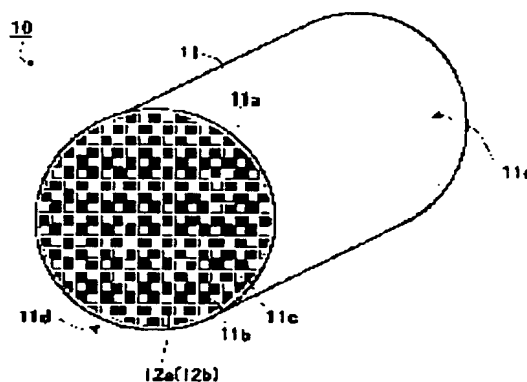
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(54) POROUS CERAMIC HONEYCOMB FILTER

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a porous ceramic honeycomb filter which has a porous ceramic honeycomb structure, has an outer peripheral wall and many cells surrounded by cell walls on the inner peripheral side of the outer peripheral walls and the one end face of which is sealed by using a sealant, for collecting fine particles contained in exhaust gas by the cell walls by making the exhaust gas pass through the pores of the cell walls and flow through the adjacent cells and whose fine particle collecting efficiency is high and whose pressure loss is low even when the porosity of the cell wall is $\geq 55\%$ and a catalyst is deposited on the porous ceramic honeycomb filter.

SOLUTION: The porosity of the cell wall is 55-75%, the average pore size is 10-40 μm and the surface roughness (the maximum height R_y) is $\geq 10 \mu\text{m}$.



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CLAIMS

[Claim(s)]

[Claim 1] The piece and face of the cell of a honeycomb structure object which has the cell of a large number surrounded with the cell wall by the inner circumference side of a peripheral wall and this peripheral wall is *** (ed) by *** material. It is the porosity ceramic honeycomb filter which carries out uptake of the particle which is made to pass the pore of said cell wall and is contained in a contiguity cell in exhaust gas at a sink and exhaust gas with said cell wall. The porosity ceramic honeycomb filter with which the porosity of said cell wall is characterized by an average pore diameter being [10-40 micrometers and surface roughness (maximum height Ry)] 10 micrometers or more 55 to 75%.

[Claim 2] The porosity ceramic honeycomb filter according to claim 1 characterized by the porosity of said cell wall being 60 - 70%.

[Claim 3] The porosity ceramic honeycomb filter according to claim 1 or 2 characterized by the main crystal of the ceramics which constitutes said cell wall being cordierite.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the porosity ceramic honeycomb filter which carries out uptake of the particle contained in exhaust gas, such as a diesel power plant.

[0002]

[Description of the Prior Art] The cutback of the harmful matter contained in the exhaust gas discharged from engines, such as an automobile, from the maintenance side of a local environment or earth environment is called for. In order to carry out uptake of the particle especially contained in exhaust gas, such as a diesel power plant, a porosity ceramic honeycomb filter (henceforth (a "porosity ceramic honeycomb filter" is omitted and) a "honeycomb filter") attracts attention, and has come to be used.

[0003] Drawing 1 is the perspective view of a honeycomb filter 10, and drawing 2 is type section drawing of the honeycomb filter 10 of drawing 1. As shown in drawing 1 and drawing 2, usually a honeycomb filter 10 The porosity ceramic honeycomb structure object which has cel 11c of a large number which were approximately cylindrical and were surrounded by cell wall 11b by the inner circumference side of peripheral-wall 11a and this peripheral-wall 11a (Hereafter, a "porosity ceramic honeycomb structure object" is omitted and it is called a "honeycomb structure object") The ends side of 11d and runoff side 11e is ***** (ed) by the ***** material 12a and 12b by turns the inflow side of cel 11c of 11. And the honeycomb filter 10 is contained by the metal vessel by the planar pressure of grasping members, such as a ceramic fiber mat inserted as a compression condition within the metal vessel (not shown).

[0004] Exhaust gas clarification with a honeycomb filter 10 is performed as follows. By drawing 2, exhaust gas flows from cel 11c which is carrying out opening by 11d the inflow side of a honeycomb filter 10 (10a shows), flows in a contiguity cel from the pore (not shown) formed in cell wall 11b, and is discharged from runoff side 11e (10b shows). And in case the particle contained in exhaust gas passes in a contiguity cel from the pore which continues within cell wall 11b, it is filtered, and uptake is carried out. And if the particle by which uptake was carried out becomes more than a constant rate, combustion clearance will be carried out by the electric heater, a burner, etc., and playback of a honeycomb filter 10 will be performed.

[0005] Moreover, there is also the approach of burning continuously about the combustion temperature of a particle in lowering and the particle which carried out uptake by supporting catalysts, such as a platinum group metal catalyst, to the pore (not shown) formed in cell wall 11b and cell wall 11b of a honeycomb filter 10. Now, it is required for a honeycomb filter 10 that the collection efficiency of a particle is high and that pressure loss should be low. If the collection efficiency of a particle is high and pressure loss is low, the increment in back pressure in the engine accompanying are recording of a particle becomes slow, the time amount which can continue uptake will become long and the interval to playback will also become long. However, generally, collection efficiency and pressure loss have the relation of reverse proportion, if it is going to make collection efficiency high, pressure loss will increase, and on the other hand, if it is going to make pressure loss low, collection efficiency will come to get worse. Although the porosity and average pole diameter of a cell wall of a honeycomb filter were adjusted so that

collection efficiency and pressure loss could be compatible conventionally, there was a limitation. Especially the thing that pressure loss becomes high compared with the filter which a high specific-surface-area ingredient blockades the pore of a cell wall, and has not coated, and is acquired for the filter of low voltage force loss with high collection efficiency since it is necessary to coat the interior of the pore of a cell wall with high specific-surface-area ingredients, such as an activated alumina, as support when burning a particle continuously with the supported catalyst was difficult.

[0006] In order to solve the above-mentioned trouble, to JP.7-163823.A in addition to making the porosity of a cell wall into 60% or less 45% or more, it goes to the interior from the front face. The specific surface area M of opening and all the pores to penetrate (m²/g) By making relation with surface roughness N (micrometer) in the filter front face into the range of 1000M+85N>530 The number of the penetrated pores which carried out the chain to the interior from filter area and a filter front face is made to increase, uptake time amount is long and the honeycomb filter which could be made to lessen the count of playback is indicated.

[0007] moreover, the thing for which porosity is set 40% or more and an average pole diameter is set to 5 micrometers or more 50 micrometers or less 55% or less at JP.8-931.A — in addition, Valley Level — by making a value into 20% or less, the detachability of the particle by which uptake was carried out to the honeycomb filter front face becomes good, and the honeycomb filter which was going to improve regeneration efficiency by back wash air is indicated. Here, it is Valley, Level Three-dimension analysis of the data of the granularity on the front face of a filter was carried out with the sensing-pin type surface roughness meter, and a field where the volume of the heights of a filter and the volume of a convex become equal to a certain field was made into the average side, and when it assumes that the filter was cut in respect of this average, it is defined as the ratio to the total surface area of the sum of the pore area in an average side.

[0008] [Problem(s) to be Solved by the Invention] However, the effectiveness that it enlarged uptake area of a cell wall in 2.3~7.4 micrometers and the example of a comparison since the honeycomb filter of the disclosure to said JP.7-163823.A is about 3.1~7.4 micrometers in the example as given [surface roughness] in the table 2 of this official report was not acquired, but the problem that the collection efficiency of a particle was also low had it substantially. For this reason, pressure loss was low and it was difficult to obtain a filter with the high collection efficiency of a particle moreover.

[0009] Moreover, porosity is 55% or less 40% or more, and the honeycomb filter of the disclosure to said JP.8-931.A had the problem of being easy to increase pressure loss. Moreover, Valley Level Although the detachability of the particle by which uptake was carried out to the front face by making a value into 20% or less became good, there was also a problem that there was little effectiveness which carries out uptake of the particle in exhaust gas with a cell wall. In addition, in JP.8-931.A, a concrete publication is not found about the value of surface roughness.

[0010] It is to obtain a honeycomb filter with the high collection efficiency of the particle in exhaust gas while this invention was made in view of the above-mentioned technical problem, enlarges the porosity of a cell wall and suppresses pressure loss low.

[0011]

[Means for Solving the Problem] this invention persons were specifying the porosity in a honeycomb filter, and an average pole diameter, and making surface roughness (maximum height Ry) of a cell wall large beyond a predetermined value, acquired knowledge that the above-mentioned technical problem is solvable, and hit on an idea to this invention.

[0012] Namely, the honeycomb filter of this invention ***** the piece end face of the cel of a honeycomb structure object which has the cel of a large number surrounded with the cell wall by the inner circumference side of a peripheral wall and this peripheral wall. It is the honeycomb filter which carries out uptake of the particle which is made to pass the pore of said cell wall and is contained in a contiguity cel in exhaust gas at a sink and exhaust gas with said cell wall. The porosity of said cell wall is characterized by an average pole diameter being [10~40 micrometers and surface roughness (maximum height Ry)] 10 micrometers or more 55 to 75%.

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[0013] It is because the collection efficiency of a particle will fall, and reinforcement will also fall, if pressure loss becomes it large that porosity is less than 55% and porosity exceeds 75%, so it is not suitable as a filter for particle uptake to have made the porosity of a cell wall into 55 ~ 75% here. The more desirable range of porosity is 60 ~ 70%.

[0014] Moreover, it is because a detailed particle will penetrate a cell wall, and collection efficiency will fall, and reinforcement will also fall, if pressure loss becomes it large that an average pole diameter is less than 10 micrometers and an average pole diameter exceeds 40 micrometers, so it is not suitable as a filter for particle uptake to have set the average pole diameter of a cell wall to 10~40 micrometers. In addition, porosity and an average pole diameter are measured using a mercury pressure close type porosimeter.

[0015] Moreover, it is because it becomes possible [having set surface roughness (maximum height Ry) of a cell wall to 10 micrometers or more] to carry out uptake of the particle efficiently by the uneven section formed in the cell wall front face in spite of having set up porosity 55 to 75%, so that 10~40 micrometers and pressure loss may be low suppressed in an average pole diameter. There is little effectiveness that the surface roughness (maximum height Ry) of a cell wall carries out uptake of the particle in exhaust gas with a cell wall in less than 10 micrometers, and it is not suitable as a filter for particle uptake. In addition, the more desirable range of the surface roughness (maximum height Ry) of a cell wall is 20~100 micrometers.

[0016] And as for the main crystal of the ceramics which constitutes a cell wall, it is desirable that it is cordierite. Although it is because thermal resistance sufficient as a filter for particle uptake, thermal shock resistance, and a mechanical strength are obtained as the main crystal of the ceramics which constitutes a cell wall is cordierite, this invention is not limited to this and can use ingredients, such as other heat-resistant ceramics, for example, a mullite, an alumina, silicon nitride, silicon carbide, nitriding aluminum, lithium aluminum silicate, aluminum titanate, and a zirconia.

[0017]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of invention is explained to a detail.

[0018] The honeycomb filter 10 shown in drawing 1 thru/ or drawing 2 was produced as follows. (Adjustment of basic-raw-materials powder) Powder, such as a kaolin, talc, a silica, hydroxylation aluminum, and an alumina, was measured, and ceramic raw material powder was adjusted so that chemical composition might become 2.47 ~ 53% of SiO₂, 20.33~ 38% of aluminum, and MgO:12~16% with a mass ratio.

[0019] (Honeycomb structure plastic matter adjustment of the body and its function) As a shaping assistant, as binders, such as methyl cellulose, and lubricant, and an osmoly agent, the amount of graphite, wheat flour, starch, resin powder, a foaming agent, etc. was changed, and it added, and mixed enough by dry type to ceramic raw material powder. Subsequently, the water of the amount of conventions was poured in, still more sufficient mixing was performed, and after shaping which mentions later, and baking, the plastic matter was produced so that various kinds of porosity of a honeycomb structure object, an average pole diameter, and surface roughness (maximum height Ry) might be obtained.

[0020] (Extrusion molding) Next, extrusion molding of the plastic matter was carried out using the extrusion molding die of general structure, and the cross section surrounded with a cell wall produced the Plastic solid which has square-like honeycomb structure.

[0021] (Baking) The Plastic solid which has honeycomb structure was calcinated using the batch type firing furnace, and 150mm and cell wall thickness acquired the honeycomb structure baking object with which the number of cells per two consists of nature ceramics of cordierite with which the outer diameter of peripheral-wall 11a has 150mm, and die length has the surface roughness (maximum height Ry) of various kinds of porosity, an average pole diameter, and a cell wall by 16 pieces 1 cm 0.43mm.

[0022] (***** Next, after sticking a masking film on the ends side of the baking object which has honeycomb structure with adhesives, it punched so that it might become a checker, and checkered ***** material was introduced into the edge, the eye closure section was formed, and the honeycomb filter 10 was obtained.

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[0023] (Measurement of porosity, an average pole diameter, and surface roughness (maximum height Ry)) The sample was started from the obtained honeycomb filter 10, and (N) and the porosity of a cell wall, an average pole diameter (micrometer), and surface roughness (maximum height Ry) were measured. In addition, the porosity (N) and average pole diameter (micrometer) of a cell wall were measured with the method of mercury penetration using the auto pore II9410 made from Micromeritics. Moreover, surface roughness (maximum height Ry) is B (JIS). It is (ed) to 0601-1994 and several places were measured.

[0024] (Measurement of collection efficiency and pressure loss) a honeycomb filter — ten — particle size — 0.042 — micrometer — carbon — powder — three — g/h — two — an hour — having supplied — the back — (— a —) — collection efficiency — (— g/h —) — [(input—discharge) — / (input —) — an inflow — a side — the differential pressure of 11d and runoff side 11e — having measured. And differential pressure was made into (b) pressure loss (mmAq). Moreover, it was evaluated from on practical use, having used as NG (x) that to which (a) collection efficiency is 90% or more, and (b) pressure loss exceeds [less than 360 mmAq (c) good (O) and 400mmAq for A (O) and 360 ~ 400mmAq (c). Moreover, collection efficiency evaluated less than 90% of thing as NG (x).

[0025] The result of (a) collection efficiency over the porosity, the average pole diameter, and surface roughness of a honeycomb filter 10, (b) pressure loss, and (c) assessment is shown in a table 1.

[0026]

[A table 1]

試料番号	平均孔径 (μm)	表面粗さ (μm)	集塵効率 (%)	圧力損失 (mmAq)	評価
発明例 1	62.8	14.8	15~30	95	382 O
発明例 2	62.4	14.4	45~55	97	378 O
発明例 3	65.4	14.8	67~89	98	381 O
発明例 4	60.2	18.8	68~78	98	382 O
発明例 5	66.8	19.8	67~74	98	377 O
発明例 6	67.2	21.8	63~79	98	365 O
発明例 7	65.5	20.8	77~84	98	353 O
発明例 8	65.2	22.2	45~82	98	378 O
発明例 9	58.8	14.9	47~68	98	298 O
発明例 10	70.1	19.7	67~78	98	332 O
比較例 1	62.4	14.8	3~7	87	378 x
比較例 2	62.2	7.7	3~7	98	448 x
比較例 3	61.0	8.1	17~14	98	420 x
比較例 4	69.1	48.3	32~35	82	327 x
比較例 5	76.2	30.4	51~70	80	310 x

[0027] As for the examples 1~10 of invention, a table 1 shows that porosity serves as few honeycomb filters 10 of pressure loss with high and collection efficiency since 55 ~ 75% and an average pole diameter are [10~40 micrometers and surface roughness (maximum height Ry)] 10 micrometers or more.

[0028] On the other hand, as for the examples 1~5 of a comparison, in porosity, an average pole diameter, or surface roughness (maximum height Ry), the assessment of the porosity of 55 ~ 75%, the average pole diameter of 10~40 micrometers, and 10 micrometers or more of surface roughness (maximum height Ry) which is collection efficiency and/or pressure loss since it is out of range is low.

[0029]

[Effect of the Invention] Since the honeycomb filter of this invention sets porosity and is setting the average pole diameter to 10~40 micrometers 55 to 75% as explanation in a detail, low voltage force loss is acquired and surface roughness on the front face of a cell wall is set to 10 micrometers or more above, it becomes possible to carry out uptake of the particle in exhaust gas with a well head, and becomes effective [uptake time amount].

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the perspective view of a honeycomb structure object.

[Drawing 2] It is the cross section of an example of the exhaust gas clarification filter 10 using the honeycomb structure object of drawing 1.

[Description of Notations]

10a: Inflow

10b: Blowdown

10: Porosity ceramic honeycomb filter (honeycomb filter)

11: Porosity ceramic honeycomb structure object (honeycomb structure object)

11a: Peripheral wall

11b: Cell wall

11c: Cell

11d: Inflow side

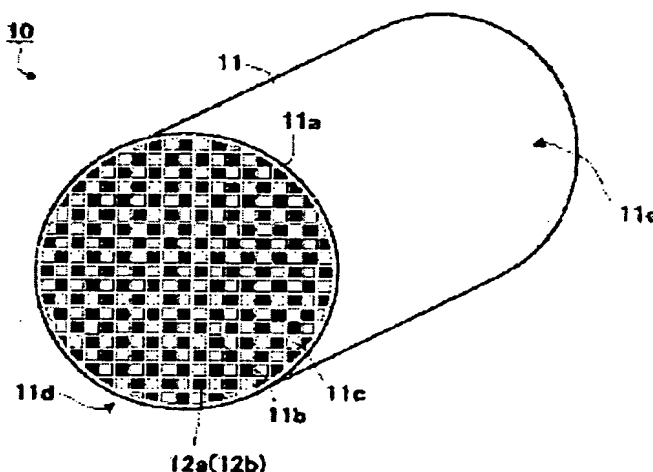
11e: Runoff side

12a, 12b: *** material

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POROUS CERAMIC HONEYCOMB FILTER**Publication number:** JP2003001029**Publication date:** 2003-01-07**Inventor:** SUWABE HIROHISA; OTSUBO YASUHIKO**Applicant:** HITACHI METALS LTD**Classification:****- international:** *F01N3/02; B01D39/20; C04B38/00; F01N3/02; B01D39/20; C04B38/00; (IPC1-7): B01D39/20; C04B38/00; F01N3/02***- european:****Application number:** JP20010184060 20010618**Priority number(s):** JP20010184060 20010618[Report a data error here](#)**Abstract of JP2003001029**

PROBLEM TO BE SOLVED: To obtain a porous ceramic honeycomb filter which has a porous ceramic honeycomb structure, has an outer peripheral wall and many cells surrounded by cell walls on the inner peripheral side of the outer peripheral walls and the one end face of which is sealed by using a sealant, for collecting fine particles contained in exhaust gas by the cell walls by making the exhaust gas pass through the pores of the cell walls and flow through the adjacent cells and whose fine particle collecting efficiency is high and whose pressure loss is low even when the porosity of the cell wall is $\geq 55\%$ and a catalyst is deposited on the porous ceramic honeycomb filter. **SOLUTION:** The porosity of the cell wall is 55-75%, the average pore size is 10-40 μm and the surface roughness (the maximum height R_y) is $\geq 10 \mu\text{m}$.



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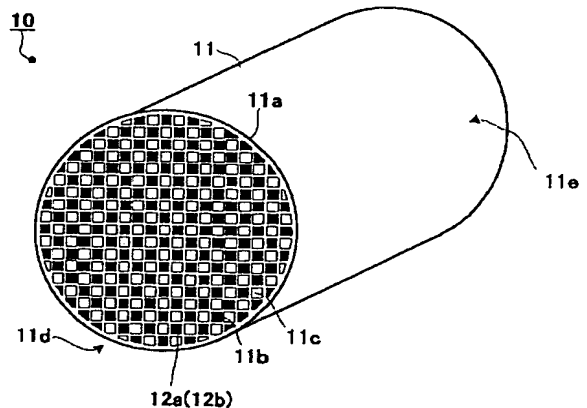
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(54) 【発明の名称】 多孔質セラミックハニカムフィルタ

(57) 【要約】

【課題】 外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有する多孔質セラミックハニカム構造体のセルの片端面を目封じ材で目封じして、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集するセラミックハニカムフィルタであって、気孔率が55%以上として触媒を担持しても、排気ガス中の微粒子の捕集効率が高かつ圧力損失が少ないハニカムフィルタを得る。

【解決手段】 セル壁の気孔率を55~75%、平均細孔径を10~40 μ m、かつ表面粗さ(最大高さRy)を10 μ m以上とする。



【特許請求の範囲】

【請求項1】 外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有するハニカム構造体のセルの片端面を目封じ材で目封じして、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集する多孔質セラミックハニカムフィルタであって、前記セル壁の気孔率が55～75%、平均細孔径が10～40 μ m、表面粗さ（最大高さRy）が10 μ m以上であることを特徴とする多孔質セラミックハニカムフィルタ。

【請求項2】 前記セル壁の気孔率が60～70%であることを特徴とする請求項1記載の多孔質セラミックハニカムフィルタ。

【請求項3】 前記セル壁を構成するセラミックスの主結晶がコージェライトであることを特徴とする請求項1又は請求項2記載の多孔質セラミックハニカムフィルタ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、ディーゼルエンジンなどの排気ガスに含まれる微粒子を捕集する多孔質セラミックハニカムフィルタに関する。

【0002】

【従来技術】地域環境や地球環境の保全面から、自動車などのエンジンから排出される排気ガスに含まれる有害物質の削減が求められている。特にディーゼルエンジンなどの排気ガスに含まれる微粒子を捕集するため、多孔質セラミックハニカムフィルタ（以下、「多孔質セラミックハニカムフィルタ」を略して「ハニカムフィルタ」という）が注目され、実用されるようになってきた。

【0003】図1はハニカムフィルタ10の斜視図であり、図2は、図1のハニカムフィルタ10の模式断面図である。図1及び図2に示すように、通常、ハニカムフィルタ10は、略円筒状で、外周壁11aと、この外周壁11aの内周側でセル壁11bにより囲まれた多数のセル11cを有する多孔質セラミックハニカム構造体（以下、「多孔質セラミックハニカム構造体」を略して「ハニカム構造体」という）11でのセル11cの流入側11d、流出側11eの両端面を交互に目封じ材12a、12bで目封じしている。そして、ハニカムフィルタ10は、金属容器（図示せず）内で圧縮状態として介挿されたセラミック繊維マットなどの把持部材の面圧で金属容器に収納されている。

【0004】ハニカムフィルタ10での排気ガス浄化は、以下の通り行われる。図2で、排気ガスは、ハニカムフィルタ10の流入側11dで開口しているセル11cから流入（10aで示す）し、セル壁11bに形成された細孔（図示せず）から隣接セルに流れ、流出側11eから排出（10bで示す）する。そして、排気ガス中

に含まれる微粒子などは、セル壁11b内で連続する細孔から隣接セルに通過する際に濾過され、捕集される。そして、捕集された微粒子が一定量以上になると、電気ヒーターやバーナ等で燃焼除去されハニカムフィルタ10の再生が行われる。

【0005】また、ハニカムフィルタ10のセル壁11bやセル壁11bに形成した細孔（図示せず）に白金金属触媒などの触媒を担持することにより、微粒子の燃焼温度を下げ、捕集した微粒子を連続的に燃焼させる方法もある。さて、ハニカムフィルタ10には、微粒子の捕集効率が高いことと、圧力損失が低いことが要求される。微粒子の捕集効率が高く、圧力損失が低ければ、微粒子の蓄積に伴うエンジンへの背圧増加が遅くなって、捕集を継続できる時間が長くなり、再生までのインターバルも長くなる。しかし、一般的に捕集効率と圧力損失は反比例の関係にあり、捕集効率を高くしようとすると圧力損失が増大し、一方、圧力損失を低くしようとすると捕集効率が悪化するようになる。従来、捕集効率と圧力損失が両立できるよう、ハニカムフィルタのセル壁の気孔率や平均細孔径を調整していたが限界があった。特に、担持した触媒で微粒子を連続的に燃焼させる場合、担体として活性アルミナ等の高比表面積材料をセル壁の細孔内部にコーティングする必要があることから、高比表面積材料がセル壁の細孔を閉塞してしまい、コーティングしていないフィルタに比べ圧力損失が高くなって、高捕集効率で低圧力損失のフィルタを得ることは困難であった。

【0006】上記問題点を解決するため、特開平7-163823号公報には、セル壁の気孔率を45%以上60%以下とすることに加えて、その表面から内部に向かって開口および貫通する全細孔の比表面積M（ m^2/g ）と、そのフィルタ表面における表面粗さN（ μm ）との関係を $1000M+85N \geq 530$ の範囲とすることで、フィルタ面積とフィルタ表面から内部に連鎖して貫通した細孔の数を増加させ、捕集時間が長く、再生回数を少なくできるようにしたハニカムフィルタが開示されている。

【0007】また、特開平8-931号公報には、気孔率を40%以上55%以下、平均細孔径を5 μm 以上50 μm 以下とすることに加えて、Valley Levelなる値を20%以下とすることで、ハニカムフィルタ表面に捕集された微粒子の剥離性が良くなり、逆洗エアによる再生効率を良くしようとしたハニカムフィルタが開示されている。ここで、Valley Level

とは、触針式表面粗さ計によりフィルタ表面の粗さのデータを3次元解析して、ある面に対してフィルタの凸部の体積と凹部の体積とが等しくなるような面を平均面とし、この平均面でフィルタを切断したと仮定したとき、平均面における細孔面積の和の全表面積に対する比率と定義している。

【0008】

【発明が解決しようとする課題】しかしながら、前記特開平7-163823号公報に開示のハニカムフィルタは、表面粗さが、同公報の表2に記載のとおり、実施例で2.3~7.4 μm 、比較例で3.1~7.4 μm 程度であるため、セル壁の捕集面積を大きくする効果は得られず、実質的に微粒子の捕集効率も低いという問題があった。このため、圧力損失が低く、しかも微粒子の捕集効率が高いフィルタを得ることは困難であった。

【0009】また、前記特開平8-931号公報に開示のハニカムフィルタは、気孔率が40%以上55%以下であり、圧力損失が増加し易いという問題があった。また、Valley Level なる値を20%以下とすることで表面に捕集された微粒子の剥離性が良くなるものの、排気ガス中の微粒子をセル壁で捕集する効果が少ないという問題もあった。なお、特開平8-931号公報には、表面粗さの値に関して具体的な記載は見当たらない。

【0010】本発明は、上記課題に鑑みてなされたもので、セル壁の気孔率を大きくして圧力損失を低く抑え、排気ガス中の微粒子の捕集効率が高いハニカムフィルタを得ることにある。

【0011】

【課題を解決するための手段】本発明者らは、ハニカムフィルタでの気孔率、平均細孔径を特定し、かつセル壁の表面粗さ（最大高さ R_y ）を所定値以上に大きくすることで、上記課題が解決できるとの知見を得、本発明に想到した。

【0012】即ち、本発明のハニカムフィルタは、外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有するハニカム構造体のセルの片端面を目標として、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集するハニカムフィルタであって、前記セル壁の気孔率が55~75%、平均細孔径が10~40 μm 、表面粗さ（最大高さ R_y ）が10 μm 以上であることを特徴とする。

【0013】ここで、セル壁の気孔率を55~75%としたのは、気孔率が55%未満であると、圧力損失が大きくなり、気孔率が75%を超えると、微粒子の捕集効率が低下し、また、強度も低下するため、微粒子捕集用フィルタとしては適さないからである。気孔率のより好ましい範囲は60~70%である。

【0014】また、セル壁の平均細孔径を10~40 μm としたのは、平均細孔径が10 μm 未満であると、圧力損失が大きくなり、平均細孔径が40 μm を超えると、微細な微粒子がセル壁を透過して捕集効率が低下し、また強度も低下するため、微粒子捕集用フィルタとしては適さないからである。なお、気孔率及び平均細孔径は、水銀圧入式ポロシメータを用いて測定する。

【0015】また、セル壁の表面粗さ（最大高さ R_y ）を10 μm 以上としたのは、気孔率を55~75%、平均細孔径を10~40 μm と圧力損失が低く抑えられるよう設定しているにもかかわらず、セル壁表面に形成された凸凹部により微粒子を効率よく捕集することが可能となるからである。セル壁の表面粗さ（最大高さ R_y ）が10 μm 未満では、排気ガス中の微粒子をセル壁で捕集する効果が少なく、微粒子捕集用フィルタとしては適さない。なお、セル壁の表面粗さ（最大高さ R_y ）のより好ましい範囲は、20~100 μm である。

【0016】そして、セル壁を構成するセラミックスの主結晶はコーージェライトであることが好ましい。セル壁を構成するセラミックスの主結晶がコーージェライトであると、微粒子捕集用フィルタとして十分な耐熱性、耐熱衝撃性、機械的強度が得られるからであるが、本発明はこれに限定されるものではなく、その他の耐熱性セラミックス、例えば、ムライト、アルミナ、窒化珪素、炭化珪素、窒化アルミ、リチウムアルミニウムシリケート、チタン酸アルミニウム、ジルコニア、等の材料を使用することができる。

【0017】

【発明の実施の形態】以下、発明の実施の形態を詳細に説明する。

【0018】図1乃至図2に示すハニカムフィルタ10を以下のようにして作製した。

（基本原料粉末の調整）カオリン、タルク、シリカ、水酸化アルミ、アルミナなどの粉末を計量して、化学組成が質量比で、 SiO_2 :47~53%、 Al_2O_3 :32~38%、 MgO :12~16%となるようにセラミックス原料粉末を調整した。

【0019】（ハニカム構造体用の坯土調整）セラミックス原料粉末に対し、成形助剤としてメチルセルローズ等のバインダ及び潤滑剤、造孔剤として、グラファイト、小麦粉、でん粉、樹脂粉、発泡剤などの量を変えて添加し、乾式で十分混合した。次いで、規定量の水を注入して更に十分な混合を行い、後述する成形及び焼成後、ハニカム構造体の各種の気孔率、平均細孔径及び表面粗さ（最大高さ R_y ）が得られるよう坯土を作製した。

【0020】（押出成形）次に、坯土を一般的な構造の押出成形用金型を用いて押出成形し、セル壁で囲まれる断面が四角形状のハニカム構造を有する成形体を作製した。

【0021】（焼成）ハニカム構造を有する成形体を、バッチ式焼成炉を用いて焼成を行い、外周壁11aの外径が150mm、長さが150mm、セル壁厚が0.43mm、1 cm^2 当たりのセル数が16個で、各種の気孔率、平均細孔径、セル壁の表面粗さ（最大高さ R_y ）を有するコーージェライト質セラミックスからなるハニカム構造焼成体を得た。

【0022】(目封じ)次に、ハニカム構造を有する焼成体の両端面にマスキングフィルムを接着剤で貼り付けた後、市松模様となるように穿孔し、端部に市松模様の目封じ材を導入し、目封止部を形成し、ハニカムフィルタ10を得た。

【0023】(気孔率、平均細孔径、表面粗さ(最大高さRy)の測定)得られたハニカムフィルタ10から試料を切り出し、セル壁の気孔率(%)、平均細孔径(μm)、表面粗さ(最大高さRy)を測定した。なお、セル壁の気孔率(%)及び平均細孔径(μm)は、Micromeritics社製オートポアIII9410を用い水銀圧入法で測定した。また、表面粗さ(最大高さRy)は、(JIS)B 0601-1994に準じて数箇所測定した。

【0024】(捕集率及び圧力損失の測定)ハニカムフ

*フィルタ10に粒径0.042 μm のカーボン粉を3g/hで2時間投入した後の(a)捕集率(%)[(投入量-排出量)/(投入量)]と、流入側11dと流出側11eの差圧を測定した。そして差圧を(b)圧力損失(mmAq)とした。また実用上から、(a)捕集率が90%以上で、かつ(b)圧力損失が、360mmAq未満を優(◎)、360~400mmAqを良(○)、400mmAqを超えるものをNG(×)として評価(c)した。また、捕集率が90%未満のものはNG(×)として評価した。

【0025】表1に、ハニカムフィルタ10の気孔率、平均細孔径及び表面粗さに対する、(a)捕集率、(b)圧力損失、(c)評価の結果を示す。

【0026】

【表1】

	気孔率 (%)	平均細孔径 (μm)	表面粗さ Ry(μm)	(a)捕集率 (%)	(b)圧力損失 (mmAq)	(c)評価
発明例1	62.8	14.9	15~30	95	382	○
発明例2	62.4	14.4	48~68	97	378	○
発明例3	65.4	14.6	67~89	98	381	○
発明例4	60.2	16.8	68~76	98	382	○
発明例5	66.8	19.5	57~74	96	377	○
発明例6	67.2	21.8	83~79	98	385	○
発明例7	65.5	30.8	22~44	96	353	◎
発明例8	68.3	33.7	45~62	98	328	◎
発明例9	56.8	14.9	47~68	99	396	○
発明例10	70.1	19.7	67~78	96	332	◎
比較例1	62.4	14.8	3~7	87	378	×
比較例2	45.2	7.7	3~7	98	448	×
比較例3	61.0	9.1	12~14	98	420	×
比較例4	69.1	48.3	32~55	82	322	×
比較例5	76.2	30.4	51~70	80	310	×

【0027】表1から、発明例1~10は、気孔率が55~75%、平均細孔径が10~40 μm 、表面粗さ(最大高さRy)が10 μm 以上であるので、捕集率が高く、かつ圧力損失の少ないハニカムフィルタ10となっていることがわかる。

【0028】一方、比較例1~5は、気孔率、平均細孔径、表面粗さ(最大高さRy)の何れかが、気孔率55~75%、平均細孔径10~40 μm 、表面粗さ(最大高さRy)10 μm 以上の範囲外であるので、捕集率及び/又は圧力損失の評価が低くなっている。

【0029】

【発明の効果】以上詳細に説明のとおり、本発明のハニカムフィルタは、気孔率を55~75%、平均細孔径を10~40 μm としていることから、低圧力損失が得られ、セル壁表面の表面粗さを10 μm 以上としているため、排気ガス中の微粒子を高効率で捕集することが可能となり、捕集時間の延長が可能となる。

【図面の簡単な説明】

【図1】ハニカム構造体の斜視図である。

【図2】図1のハニカム構造体を用いた排気ガス浄化フィルタ10の一例の断面模式図である。

【符号の説明】

10a: 流入

10b: 排出

10: 多孔質セラミックハニカムフィルタ(ハニカムフィルタ)

11: 多孔質セラミックハニカム構造体(ハニカム構造体)

11a: 外周壁

11b: セル壁

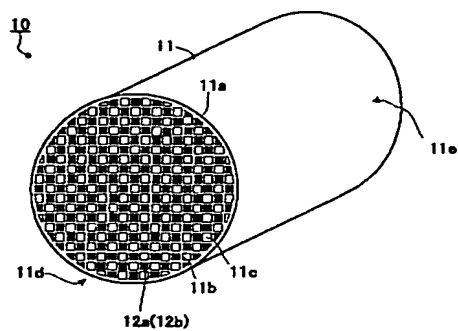
11c: セル

11d: 流入側

11e: 流出側

12a, 12b: 目封じ材

【図1】



【図2】

